Douglas-fir Beetle

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DETERIORATION OF BEETLE-KILLED DOUGLAS-FIR IN THE MILLICOMA AREA

OF COOS COUNTY, OREGON

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PROGRESS REPORT

DETERIORATION OF BEETLE-KILLED DOUGLAS-FIR IN THE MILLICOMA AREA OF COOS COUNTY, OREGON

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SUMMARY

Deterioration analyses of 40 beetle-killed Douglas-fir trees that died during the period 1946-51 in the Millicoma Forest of Coos County, Oregon, were made in September, 1952. A summary of the findings of these analyses is as follows:

1. Decay of the sapwood, which on the average represented 21.3 percent of the total volume of the study trees, is well advanced after two years and practically complete after three years.

2. Significant decay of the heartwood of beetle-killed trees does not begin until after the fourth year following kill.

3. At the end of six years approximately 75 percent of the volume of beetle-killed trees is still sound.

4. Where a choice exists, trees with broken tops should be removed first, since rot advances much more rapidly in these trees.

5. Penetration by wood-boring insects in the study trees occurred at about the same rate and in conjunction with the rot. However, activity by borers will likely be accelerated because of the large amount of favorable breeding material now available.

6. On individual trees there appeared to be a strong correlation between location and intensity of attack by the Douglas-fir beetle and subsequent progress of decay.

7. The results of this study to date are preliminary and apply directly only to the study area. They are released for lack of better data.

INTRODUCTION

A serious epidemic of the Douglas-fir beetle (Dendroctonus pseudotsugae Hopk.) has caused widespread killing of Douglas-fir timber in western Oregon and southern Washington since 1951. More than one billion board feet were killed the first year of the outbreak and the losses are expected to continue at this or greater intensity for several years.

Concerted efforts are being made through salvaging the currently infested timber to reduce the intensity of the bark beetle outbreak. However, much of the affected timber is too remote from present roads to permit prompt salvage. Some cannot be reached for many years; hence, in scheduling salvage operations it is important to know how long the beetle-killed timber will remain merchantable. The following preliminary report, which describes the results of deterioration analyses of 40 trees that died in Coos County, Oregon, since 1946 is the initial phase of studies to provide answers for this problem.

The analysis of the data recorded to date has been completed and is reported herein; however, it should be considered as preliminary to more comprehensive studies which the Division of Forest Pathology and the Division of Forest Insect Investigations plan to continue in 1953. While a total of 40 trees were analyzed this fall, they were selected so as to approximately equally represent each of the preceeding six years in which mortality occurred. This did not allow a great amount of data on which to draw conclusions for any one year. Certain trends, however, have been observed and these will be discussed in detail.

The present study was a cooperative undertaking of the Division of Forest Pathology, U. S. Bureau of Plant Industry, Soils and Agricultural Engineering; the Division of Forest Insect Investigations, U. S. Bureau of Entomology and Plant Quarantine; and Weyerhaeuser Timber Company. Special acknowledgment is made to Messrs. D. Watson and J. E. Lodewick of the Company, who participated in the taking of the field data, and to R. O. Cornelius, Weyerhaeuser Branch Forester at Coos Bay, who arranged for the falling and bucking of the study trees and assistance by other staff members.

COLLECTION AND ANALYSIS OF DATA

The trees felled for analysis were from permanent mortality study plots maintained by the Portland Forest Insect Laboratory and Weyerhaeuser Timber Company on the Company's Millicoma Forest, which is located some 25 miles east of Coos Bay, Oregon. Although no beetle epidemic was in progress until 1951, a number of trees have died and been recorded annually since the plots were established in 1946. For the present study approximately equal numbers of trees killed in each of the intervening six years were selected for dissection and analysis. The dated trees were felled and bucked into log lengths during the week of September 8-12, 1952, and examined in detail in the field.

In recording the data, the average depth of both sapwood and decay was measured so that it was possible to compute their volumes separately. Incipient decay and stain were noted but not included in volume computations. These factors may, however, cause some additional degrading at the mill but no attempt was made here to classify logs by grade. Observations were also made of the incidence of attack and damage caused by wood-boring beetles.

The tree measurements and rot data collected in the field were plotted on U. S. Forest Service Form 558a 1/ and the volumes computed by planimeter in cubic feet. Gross volume was taken from a two foot stump to a six-inch top.

SUMMARY OF DATA

Results of the deterioration analysis of trees that died since 1946 are shown in tables 1, 2 and 3. Table 1 presents the gross volume of the killed trees, the volume of decay that has occurred in both sapwood and heartwood, and the present sound volume. Since there is an uneven distribution of diameter classes represented and consequently a variation in volume of the fast-decaying sapwood from tree to tree, the same data are presented on a percentage basis in Table 2. Table 3 shows the percent of sapwood, by diameter classes, in the 40 trees dissected.

1/ This graph form was devised by Reineke. The abscissa values are plotted in terms of tree height while the ordinate values are in terms of diameter based on cross sectional area.

Table 1. - Volume of Decayed and Sound Wood in Douglas-fir trees killed since 1946.

Years	Date of Death	Number Trees	Gross Volume (Cu.Ft.)	Decay Volume		Net Volume Sound Wood (Cu.Ft.)
				Sapwood (Cu.Ft.)	Heartwood (Cu.Ft.)	
1	1951	6	1829.5	33.6	--	1795.9
2	1950	5	1464.1	216.9	22.8	1224.4
3	1949	6	652.4	45.5	Trace	606.9
4	1948	8	1625.6	238.0	35.1	1352.5
5	1947	10	2538.3	534.4	162.1	1841.8
6	1946	5	884.0	178.0	39.6	666.4

Table 2. Percentage of Decayed and Sound Wood in Douglas-fir trees killed since 1946

Years	Date of Death	Number Trees	Decay		Sound Volume (Percent)
			Sapwood (Percent)	Heartwood (Percent)	
1	1951	6	1.8	--	98.2
2	1950	5	15.4	1.4	83.2
3 1/	1949	6	6.9	Trace	93.1
4	1948	8	14.6	2.2	83.2
5	1947	10	21.1	6.4	72.5
6	1946	5	20.7	5.1	74.2

1/ Includes several trees where death was not directly attributed to bark beetles.

The data in Table 2 show considerable variations, indicating that factors other than date of beetle attack are involved. One of the most important of these appears to be old broken tops. It was observed during the course of the dissection studies that beetle-killed trees with old broken tops consistently contained more decay than trees with sound tops. Likewise, the time of death in the more recent kills needs to be designated as spring or fall. Trees killed in the spring of 1951 are actually two years old since they have passed through two full growing seasons where temperatures are most favorable for the development of decay. Trees dying in the fall of 1951 are truly in the one-year age class. It was also noted that trees killed by suppression or other factors regularly contained less decay than trees killed by beetles. With all these variations affecting the data so far assembled it is evident that considerably more information is needed before final conclusions can be reached.

Since sapwood is readily subject to decay, the percentage of sapwood present in trees of different diameters is of interest and is shown in the following table. Because the Millicoma forest is an even-aged stand (165 - 185 years) tree age was not considered separately; also the trees are classified without reference to date of kill.

Table 3. - Percent of Sapwood in 180-year old Douglas-fir Trees Used for Deterioration Analysis

Tree Diameter Inches	No. of Trees	Total Volume Cu. Ft.	Sapwood Volume Cu.Ft.	Percent Sapwood
13-15	2	92.5	20.4	22.1
16-18	7	475.6	95.7	20.1
19-21	4	281.4	53.3	18.9
22-24	5	687.0	125.1	18.2
25-27	3	671.9	143.6	21.4
28-30	4	917.7	223.9	24.4
31-33	6	1794.8	403.6	22.5
34-36	3	1652.4	394.4	23.9
37-39	4	1744.0	353.6	20.3
40-42	None			
43-45	1	566.4	120.0	21.2

It is perhaps sufficient to state that about one-fifth of the commercial volume of Douglas-fir in the Millicoma forest is sapwood, and it is this portion of the volume which is most subject to early loss from decay. Plate I (Figs. 1 and 2) illustrates the appearance of the sapwood of beetle-killed trees dead 2 and 5 years respectively.

DISCUSSION

On the basis of the data presented it would appear that about half of the sapwood is decayed on Dendroctonus-killed trees by the end of the second year after death. However, as stated earlier, there are considerable variations in the data collected. It so happened that four of the five trees felled in the 2-year age class either had broken tops, or were infested early in 1950 so as to be essentially the same as trees killed 3 years. These factors are believed to have led to a greater amount of decay than would be normally encountered in two years. With the collection of more data, these variations should become less pronounced.

In further considering the decay that occurs the first two years or so, it should be pointed out that since it is relatively superficial much of the rot would be slabbed-off in normal sawing at the mill.

During the course of the study it was repeatedly observed that in the more recent beetle-killed trees (1 - 3 years), there was frequently a direct correlation between the presence of the beetle galleries and the occurrence of rot. Since bark beetles, particularly Dendroctonus sp., are known to carry the spores of many fungi, this could be expected. Typically the beetle attacks begin 10 or more feet above the base of the tree and the rot usually does not immediately extend much below the lowest beetle galleries. This commonly leaves about one-third of the lower part of the butt log free of decay for approximately the first 3 years following death of the tree. Since the beetle galleries are normally most numerous in the mid-bole of the tree, this is where the decay is at first the most advanced, and consequently where the bulk of the rot is found in trees that have been dead only a few years.

A brown cubical rot caused by Fomes pinicola (Swartz)Cke. appears to be the chief cause of wood decay in the beetle-killed trees. The importance of the rot caused by Polyporus volvatus Pk., which is one of the first fruit bodies to appear on trees killed by beetles, has as yet not been determined. Other fungi such as Polyporus abietinus (Dicks) Fr. and Stereum spp. are also commonly present on beetle-killed trees.

In the Lake Creek basin of the Millicoma Forest, Poria weirii Murr. root rot was almost constantly found associated with the trees killed by beetles 5 or 6 years ago. In the majority of cases this rot occurred first in the sapwood and later in the heartwood. There were a few instances, however, where the rot occurred only in the heartwood. No P. weirii was found in trees dead less than 3 years. These data suggest that P. weirii root rot may commonly precede beetle infestations in parts of the Millicoma area. Since P. weirii does not normally extend more than 2 or 3 feet above the ground it is not regarded as influencing decay losses in beetle-killed trees very materially, at least up to six years after the death of such trees. It does, however, interfere with detecting other rots in the butt of the tree. Occasionally Polyporus schweinitzii Fr. rot was also encountered in the base of the beetle-killed trees, and when present, it generally extended higher in the butt log than P. weirii.

Damage by wood borers in the dissected trees was surprisingly light. Invasion of the dead wood by these beetles (round-headed and flat-headed borers of the families Cerambicidae and Buprestidae) seems to be at about the same rate as the decay. After 2 or 3 years the sapwood is usually well-riddled with boring holes, but with little attack on the heartwood. Considerable shallow penetration of the heartwood was found in trees dead 5 or 6 years, mainly by the flat-headed borers, and in some cases they were found well toward the center of the trees. In general, however, serious degrade of the logs had not occurred.

It is well to point out that damage by wood borers in the dissected trees may not be a good criterion of what to expect in the timber killed in the present epidemic, since the much larger amounts of breeding material now on hand might well result in much greater buildup and increased damage by the borers than under endemic conditions. This was the situation following the Tillamook Burn, when damage by borers became an important factor in deterioration of the fire-killed timber.

It is emphasized that the data presented in this report may be atypical for the Douglas-fir Region as a whole. This is already indicated by observations made in the Wind River Experimental Forest of south central Washington, where the rate of decay appears to be considerably faster. Through expanded studies the variations in deterioration rates between areas within the Region will be investigated.

PLATE I

PROGRESS OF DETERIORATION IN TREES KILLED BY
THE DOUGLAS-FIR BEETLE ON THE MILLICOMA FOREST

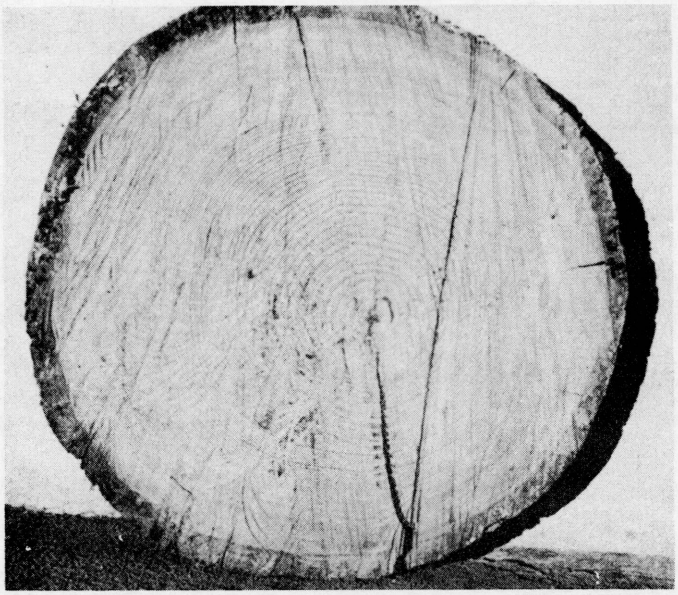

Figure 1. 18-inch section taken at 66 feet —— tree dead 2 years. Note deterioration in the outer sapwood

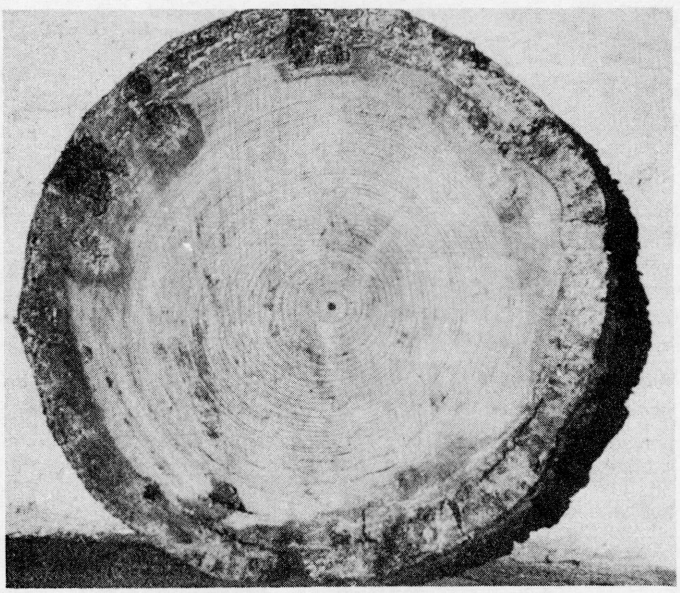

Figure 2. 20-inch section taken at 66 feet ——tree dead 5 years. Note complete deterioration of the sapwood and penetration of rot into the heartwood

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